WHAT IS CLAIMED IS:

1. A nuclear magnetic resonance measuring apparatus comprising:

an NMR probe head equipped with an NRM receiver coil and an irradiation coil;

a preamplifier, arranged in said probe head, for amplifying the NMR signal received by said NRM receiver coil;

a coil cooling heat exchanger, arranged in said probe head, for exchanging heat between said NRM receiver coil/irradiation coil and coolant;

a preamplifier, arranged inside said probe head, for exchanging heat between said preamplifier and coolant;

a cooling device capable of cooling and compressing the coolant;

a first transfer tube for transferring the coolant from said cooling device to said probe head;

a second transfer tube for transferring the coolant from said probe head to said cooling device;

a third transfer tube for transferring the coolant from said cooling appropriate to said probe head; and

a fourth transfer tube for transferring the coolant from said probe head to said cooling device;

said nuclear magnetic resonance measuring

apparatus further characterized in that:

said cooling device further comprises:

a cryo-cooler further containing a first cooling stage having a first stage heat exchanger and a second cooling stage having a second stage heat exchanger;

a compressor for compressing the coolant;

a first counter-flow heat exchanger and

a second counter-flow heat exchanger;

said first cooling stage has a first stage temperature higher than the second stage temperature of said second cooling stage;

said compressor is capable of circulating the coolant via the path consisting of said first counter-flow heat exchanger, third transfer tube, preamplifier heat exchanger, fourth transfer tube, first heat exchanger, second counter-flow heat exchanger, second stage heat exchanger, first transfer tube, said coil cooling heat exchanger, transfer tube, second counter-flow heat exchanger and first counter-flow heat exchanger, in that order; and

pressure control valves that all the amount of coolant passes through are arranged in series in at least one position along said coolant circulating path and are capable of reducing the pressure of the coolant passing through said pressure control valves.

2. The nuclear magnetic resonance measuring apparatus according to Claim 1 characterized in that said pressure control valves are arranged between the first counter-flow heat exchanger and the compressor along the path of said coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature much the same as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

3. The nuclear magnetic resonance measuring apparatus according to Claim 1 characterized in that at least one coolant tank is installed between the second heat exchanger and first transfer tube along said coolant path.

4. A nuclear magnetic resonance measuring apparatus comprising:

an NMR probe head equipped with an NRM receiver coil and an irradiation coil;

a preamplifier, arranged in said probe head, for amplifying the NMR signal received by said NRM receiver coil;

a coil cooling heat exchanger, arranged in said probe head, for exchanging heat between said NRM receiver coil/irradiation coil and coolant;

a preamplifier, arranged inside said probe head, for exchanging heat between said preamplifier and coolant;

a cooling device capable of cooling and compressing the coolant;

a first transfer tube for transferring the coolant from said cooling device to said probe head;

a second transfer tube for transferring the coolant from said probe head to said cooling device;

a third transfer tube for transferring the coolant from said cooling appropriate to said probe head; and

a fourth transfer tube for transferring the coolant from said probe head to said cooling device;

said nuclear magnetic resonance measuring apparatus further characterized in that:

said cooling device further comprises:

a cryo-cooler further containing a first cooling stage having a first stage heat exchanger and a second cooling stage having a second stage heat exchanger;

a compressor for compressing the coolant;

a first counter-flow heat exchanger and

a second counter-flow heat exchanger;

said first cooling stage has a first stage temperature higher than the second stage temperature of said second cooling stage;

said compressor is capable of circulating the coolant via the path consisting of said first counter-flow heat exchanger, first stage heat exchanger, third transfer tube, preamplifier heat exchanger, fourth transfer tube, second counter-flow heat exchanger, second stage heat exchanger, first transfer tube, coil cooling heat exchanger, second transfer tube, second counter-flow heat exchanger and first counter-flow heat exchanger, in that order; and

pressure control valves that all the amount of coolant passes through are arranged in series in at least one position along said coolant circulating path and are capable of reducing the pressure of the coolant passing through said pressure control valves.

5. The nuclear magnetic resonance measuring apparatus according to Claim 4 characterized in that said pressure control valves are arranged between the first counter-flow heat exchanger and the compressor along the path of said coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at the same temperature as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

6. The nuclear magnetic resonance measuring

apparatus according to Claim 4 characterized in that at least one coolant tank is installed between the second heat exchanger and first transfer tube along said coolant path.

7. A nuclear magnetic resonance measuring apparatus comprising:

an NMR probe head equipped with an NRM receiver coil and an irradiation coil;

a preamplifier, arranged in said probe head, for amplifying the NMR signal received by said NRM receiver coil;

a coil cooling heat exchanger, arranged in said probe head, for exchanging heat between said NRM receiver coil/irradiation coil and coolant;

a preamplifier, arranged inside said probe head, for exchanging heat between said preamplifier and coolant;

a cooling device capable of cooling and compressing the coolant;

a first transfer tube for transferring the coolant from said cooling device to said probe head;

a second transfer tube for transferring the coolant from said probe head to said cooling device;

a third transfer tube for transferring the coolant from said cooling appropriate to said probe head; and

a fourth transfer tube for transferring the coolant from said probe head to said cooling device;

said nuclear magnetic resonance measuring apparatus further characterized in that:

said cooling device further comprises:

a cryo-cooler further containing a first cooling stage having a first stage heat exchanger and a second cooling stage having a second stage heat exchanger;

a compressor for compressing the coolant;

a first counter-flow heat exchanger and

a second counter-flow heat exchanger;

said first cooling stage has a first stage temperature higher than the second stage temperature of said second cooling stage;

said compressor is capable of circulating the coolant via the path consisting of said first counter-flow heat exchanger, first stage heat exchanger, second counter-flow heat exchanger, second stage heat exchanger, first transfer tube, coil cooling heat exchanger, second transfer tube, second counter-flow heat exchanger, third transfer tube, preamplifier heat exchanger, fourth transfer tube and first heat exchanger, in that order; and

pressure control valves that all the amount of coolant passes through are arranged in series in at

least one position along said coolant circulating path and are capable of reducing the pressure of the coolant passing through said pressure control valves.

8. The nuclear magnetic resonance measuring apparatus according to Claim 7 characterized in that said pressure control valves are arranged between said second stage heat exchanger and first transfer tube along the path of said coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature lower than the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

9. The nuclear magnetic resonance measuring apparatus according to Claim 7 characterized in that said pressure control valves are arranged at a desired position between the first counter-flow heat exchanger and the compressor along the path of said coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature much the same as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

10. The nuclear magnetic resonance measuring apparatus according to Claim 7 characterized in that

at least one coolant tank is installed between the second heat exchanger and first transfer tube along said coolant path.

11. A nuclear magnetic resonance measuring apparatus comprising:

an NMR probe head equipped with an NRM receiver coil and an irradiation coil;

a preamplifier, arranged in said probe head, for amplifying the NMR signal received by said NRM receiver coil;

a coil cooling heat exchanger, arranged in said probe head, for exchanging heat between said NRM receiver coil/irradiation coil and coolant;

a preamplifier, arranged inside said probe head, for exchanging heat between said preamplifier and coolant;

a cooling device capable of cooling and compressing the coolant;

a first transfer tube for transferring the coolant from said cooling device to said probe head;

a second transfer tube for transferring the coolant from said probe head to said cooling device;

a third transfer tube for transferring the coolant from said cooling appropriate to said probe head; and

a fourth transfer tube for transferring the

coolant from said probe head to said cooling device;

said nuclear magnetic resonance measuring apparatus further characterized in that:

said cooling device further comprises:

a cryo-cooler further containing a first cooling stage having a first stage heat exchanger and a second cooling stage having a second stage heat exchanger;

a compressor for compressing the coolant;

a first counter-flow heat exchanger;

a second counter-flow heat exchanger; and

a third counter-flow heat exchanger;

said first cooling stage has a first stage temperature higher than the second stage temperature of said second cooling stage;

said compressor is capable of circulating the coolant in the first and second paths in parallel; wherein the first path consists of said first counter-flow heat exchanger, first stage heat exchanger, second counter-flow heat exchanger, second stage heat exchanger, first transfer tube, coil cooling heat exchanger, second transfer tube, second counter-flow heat exchanger and first counter-flow heat exchanger in that order, and the second path branches off from the first path, at the coolant branching point provided between the compressor and first counter-flow

heat exchanger in the first path; the second path being the path where coolant is fed through said third counter-flow heat exchanger, first stage heat exchanger, third transfer tube, preamplifier heat exchanger, fourth transfer tube and third counter-flow heat exchanger in that order and meets said first path at the coolant confluence provided between the first counter-flow heat exchanger and compressor in the first path; and

pressure control valves are arranged in series in at least one position of each of the first and second paths where coolant circulates, and are capable of reducing the pressure of the coolant passing through said pressure control valves.

12. The nuclear magnetic resonance measuring apparatus according to Claim 11 characterized in that said pressure control valves are arranged between the second stage heat exchanger and first counter-flow heat exchanger in the first path, and between the preamplifier heat exchanger and third counter-flow heat exchanger in the second path for said coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature lower than the ambient temperature of the place where the nuclear magnetic

resonance measuring apparatus is installed.

13. The nuclear magnetic resonance measuring apparatus according to Claim 11 characterized in that said pressure control valves are arranged at a desired position between said first counter-flow heat exchanger and coolant confluence in the first path and between the third counter-flow heat exchanger and coolant confluence in the second path, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature much the same as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

14. The nuclear magnetic resonance measuring apparatus according to Claim 11 characterized in that said pressure control valves are arranged between the coolant confluence and the compressor in the first path for the coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature much the same as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

15. The nuclear magnetic resonance measuring apparatus according to Claim 11 characterized in that

said pressure control valves are arranged between said second heat exchanger and first counter-flow heat exchanger in the first path for the coolant and between the preamplifier heat exchanger and third counter-flow heat exchanger in the second path for the coolant; at least one coolant tank is installed between the second heat exchanger and second counter-flow heat exchanger in the first path for the coolant; and said pressure control valves are capable of reducing the pressure of the coolant passing through said pressure control valves and are operated at a temperature lower than the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

16. A nuclear magnetic resonance measuring apparatus comprising:

an NMR probe head equipped with an NRM receiver coil and an irradiation coil;

a preamplifier, arranged in said probe head, for amplifying the NMR signal received by said NRM receiver coil;

a coil cooling heat exchanger, arranged in said probe head, for exchanging heat between said NRM receiver coil/irradiation coil and coolant;

a preamplifier, arranged inside said probe head,

for exchanging heat between said preamplifier and coolant;

a cooling device capable of cooling and compressing the coolant;

a first transfer tube for transferring the coolant from said cooling device to said probe head;

a second transfer tube for transferring the coolant from said probe head to said cooling device;

a third transfer tube for transferring the coolant from said cooling appropriate to said probe head; and

a fourth transfer tube for transferring the coolant from said probe head to said cooling device;

said nuclear magnetic resonance measuring apparatus further characterized in that:

said cooling device further comprises:

a cryo-cooler further containing a first cooling stage having a first stage heat exchanger and a second cooling stage having a second stage heat exchanger;

a compressor for compressing the coolant;

a first counter-flow heat exchanger and

a second counter-flow heat exchanger;

said first cooling stage has a first stage temperature higher than the second stage temperature of said second cooling stage;

said compressor is capable of circulating the

coolant via the path consisting of said first counter-flow heat exchanger, second stage heat exchanger, first transfer tube, coil cooling heat exchanger, second transfer tube and first counter-flow heat exchanger in that order; and

pressure control valves that all the amount of coolant passes through are arranged in series in at least one position along said coolant circulating path and are capable of reducing the pressure of the coolant passing through said pressure control valves.

17. The nuclear magnetic resonance measuring apparatus according to Claim 16 characterized in that said pressure control valves are arranged at a desired position between the second stage heat exchanger and first counter-flow heat exchanger along the path for the coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature lower than the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

18. The nuclear magnetic resonance measuring apparatus according to Claim 16 characterized in that said pressure control valves are arranged at a desired position between the first counter-flow heat exchanger and compressor along the path for the coolant, are

capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature much the same as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

19. The nuclear magnetic resonance measuring apparatus according to Claim 16 characterized in that at least one coolant tank is installed at a desired position between the second stage heat exchanger and second counter-flow heat exchanger along said coolant path for the coolant.

20. A nuclear magnetic resonance measuring apparatus comprising:

an NMR probe head equipped with an NRM receiver coil and an irradiation coil;

a preamplifier, arranged in said probe head, for amplifying the NMR signal received by said NRM receiver coil;

a coil cooling heat exchanger, arranged in said probe head, for exchanging heat between said NRM receiver coil/irradiation coil and coolant;

a preamplifier, arranged inside said probe head, for exchanging heat between said preamplifier and coolant;

a cooling device capable of cooling and

compressing the coolant;

a first transfer tube for transferring the coolant from said cooling device to said probe head;

a second transfer tube for transferring the coolant from said probe head to said cooling device;

a third transfer tube for transferring the coolant from said cooling appropriate to said probe head; and

a fourth transfer tube for transferring the coolant from said probe head to said cooling device;

said nuclear magnetic resonance measuring apparatus further characterized in that:

said cooling device further comprises:

a cryo-cooler further containing a first cooling stage having a first stage heat exchanger and a second cooling stage having a second stage heat exchanger;

a compressor for compressing the coolant;

a first counter-flow heat exchanger and

a second counter-flow heat exchanger;

said first cooling stage has a first stage temperature higher than the second stage temperature of said second cooling stage;

said compressor is capable of circulating the coolant via the path consisting of said first counter-flow heat exchanger, first heat exchanger, second counter-flow heat exchanger, second stage heat

exchanger, first transfer tube, coil cooling heat exchanger, second transfer tube, second counter-flow heat exchanger and first counter-flow heat exchanger, in that order; and

pressure control valves that all the amount of coolant passes through are arranged in series in at least one position along said coolant circulating path and are capable of reducing the pressure of the coolant passing through said pressure control valves.

21. The nuclear magnetic resonance measuring apparatus according to Claim 20 characterized in that said pressure control valves are arranged between the second stage heat exchanger and first counter-flow heat exchanger along the path for the coolant, are capable of reducing the pressure of the coolant passing through said pressure control valves, and are operated at a temperature lower than the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

22. The nuclear magnetic resonance measuring apparatus according to Claim 20 characterized in that said pressure control valves are arranged between the first counter-flow heat exchanger and compressor along the path for the coolant, are capable of reducing the pressure of the coolant passing through said pressure

control valves, and are operated at a temperature much the same as the ambient temperature of the place where the nuclear magnetic resonance measuring apparatus is installed.

23. The nuclear magnetic resonance measuring apparatus according to Claim 20 characterized in that at least one coolant tank is installed at a desired position between the second stage heat exchanger and second counter-flow heat exchanger along said coolant path for the coolant.

24. The nuclear magnetic resonance measuring apparatus according to Claim 20 characterized in that a second cooler different from said cryo-cooler is installed in other than said path, and heat exchange is performed between the coolant cooled by said second cooler and said preamplifier through a preamplifier heat exchanger.

25. The nuclear magnetic resonance measuring apparatus according to Claim 20 characterized in that a second coolant tank different from said coolant tank is installed in other than said path, and heat exchange is performed between the coolant stored in said second coolant tank and said preamplifier through a preamplifier heat exchanger.

26. The nuclear magnetic resonance measuring

apparatus according to any one of Claims 1, 4, 7, 11 and 20 characterized in that said first transfer tube, second transfer tube third transfer tube and fourth transfer tube are stored inside a single transfer tube storage conduit.